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XX.

HEIGHT AND VELOCITY OF CLOUDS.

By Professor E. C. Pickering.

Presented, Jan. 11, 1876.

The velocity of the wind at different altitudes is an important element in Meteorology, and the ordinary methods of measuring it are far from satisfactory. By the following method, it is believed that the velocity of the wind at considerable heights may be measured with an accuracy at least equal, and probably greater, than that of similar measurements near the surface of the earth. The apparatus consists simply of two similar camera obscuras formed of tripods covered with black cloth, and with cosmorama lenses above, which form an image of objects near the zenith on a sheet of paper placed beneath. A day is selected when cumuli clouds are crossing the sky, and the two cameras are placed at any convenient interval, as a hundred metres, in a direction nearly perpendicular to the direction of the wind. An observer with a watch is stationed at each camera, and when a cloud enters the field a signal is given, and each draws a line tangent to the edge of the cloud and parallel to the direction of the wind every half minute. At the intermediate quarter minutes, other lines are drawn perpendicular to these, and also tangent to the cloud. The first series of lines will be nearly coincident, the second at intervals marking the cloud's motion. The zenith is now marked on each drawing by suspending a plumb-line from the centre of each lens, or in some other way, and a line drawn through it parallel to the direction of the cloud's motion. It will now be found that the distance of this line from those parallel to it and tangent to the cloud is different in the two sheets by an amount equal to the parallax of the cloud, or the angle between the two cameras as seen from the cloud. The height of the cloud may then be easily determined, if we know the focal distances of the lenses and the interval between the cameras, by the proportion: Difference of distances of the two lines : focal length of lenses = interval between the cameras : required height of cloud. To determine the accuracy of this method, suppose the interval between the cameras one hundred metres, the focal lengths one metre, and the height of the cloud one kilometre; then the difference between the distances of the two lines will be a decimetre. If this distance is measured with an error no greater than a millimetre, the height will be given within ten metres, or within one per cent. The velocity per minute is then readily deduced from the lines perpendicular to the direction of the wind, and the velocity of the latter may thus be determined within one or two per cent, a degree of accuracy at least equal to that of the best determinations of the velocity of the wind at the earth's surface and much greater than the degree of uniformity of any ordinary wind. Each cloud will furnish a measurement at a different height, and a comparison with observations at the surface of the earth will readily give the relative velocities at these various altitudes.

Various other applications of this principle will suggest themselves. For instance, if the paper is replaced by a sensitive photographic plate, and the cameras directed towards a distant thunder cloud at night, an image of each flash may be taken. A great many flashes may be recorded on each plate, and the corresponding images recognized by their forms. The distances and true dimensions may then be determined with considerable accuracy. If observations are made at the same time, of the interval between the flash and the thunder, the velocity of the sound may be measured, and it may be proved whether, as has been claimed, the velocity of such an intense sound is far greater than that of any ordinary noise.